

THE COLUMBIA ROOT-KNOT NEMATODE,
MELOIDOGYNE CHITWOODI

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DISTRIBUTION AND HOSTS: In recent years, a new species of root-knot nematode, Meloidogyne chitwoodi Golden *et al.*, was described and subsequently found widely distributed in the Pacific Northwest of the United States (2,3). It is known to occur in Washington, Oregon, Idaho, California, and Nevada. It has been detected in the Columbia River drainage system which also includes the Snake River region of Idaho and Oregon. Consequently, the common name designated for this nematode is the "Columbia root-knot nematode" (2). Meloidogyne chitwoodi has probably been extensively disseminated in these regions by reused irrigation water and by the use of infected seed potatoes (3,7,8).

In the absence of control measures, M. chitwoodi may cause serious economic losses to potato, Solanum tuberosum L., particularly as it affects tuber quality. Other root-knot species, M. hapla Chitwood, and M. incognita Kofoid & White, also are known to reduce potato tuber quality in North America. In Florida, M. incognita commonly occurs on potato. In the Pacific Northwest, 9 million dollars are spent annually to control M. chitwoodi and M. hapla (7).

Meloidogyne chitwoodi is known to have a wide host range. In one study, M. chitwoodi was found to reproduce on 53 of 68 plant species tested (4). In addition to potato, some common hosts are barley, Hordeum vulgare L.; corn, Zea mays L.; oats, Avena sativa L.; sugarbeet, Beta vulgaris L.; tomato, Lycopersicon esculentum Mill.; and wheat, Triticum aestivum L. (4,8). Certain cultivars can be used to differentiate the three principal root-knot species occurring on potato in North America (3). For example, M. hapla and M. incognita reproduce on pepper, Capsicum frutescens L. 'California Wonder', whereas M. chitwoodi does not reproduce on this cultivar. Peanut, Arachis hypogaea L. 'Florrunner', is a host of M. hapla but is not a host of M. chitwoodi or M. incognita.

TAXONOMIC DIFFERENCES: Meloidogyne chitwoodi resembles M. hapla but differs in that the perineal pattern in M. chitwoodi appears round to oval with broken, curved, or twisted striae above the anal area. Punctations occur in the anal region of the perineal pattern of M. hapla, but they have not been observed in M. chitwoodi. An important character for identification is the vesicle-like structures which occur in the median bulb region adjacent to the lumen of M. chitwoodi females. Similar vesicle structures have only been observed in larvae and males of M. nassi Franklin. The larval tail of M. chitwoodi is usually short and blunt, having less taper to its rounded terminus than larval tails of M. hapla and M. incognita. Some populations of M. hapla have larvae with bifid or "toe-shaped" tails (2,3).

SYMPTOMS: On many hosts M. chitwoodi infection may produce only slight or no galling on roots unless multiple infections occur in some areas of the root, whereas M. hapla usually forms small but distinct galls (6). Swellings on potato tubers are usually quite conspicuous. With the aid of a hand lens, spherical females of M. chitwoodi can be observed protruding from roots, and each female may be surrounded posteriorly with a large egg-mass which turns dark-brown with age.

On 'Russet Burbank' potato, M. chitwoodi causes the development of giant cells in the phloem tissues of roots, stolons, and tubers. Other cellular changes that are induced by M. chitwoodi are increased protoplasmic density, enlargement of nucleoli, division of nuclei, hypertrophy, and lignification of cortical cell walls (1). Brownish lesions, resulting from lignification of cortical cells, are symptomatic of tuber infection (Fig. 1).

ENVIRONMENTAL CONSIDERATIONS: Lignification of cells adjacent to the egg mass results in a protective layer that aids in the survival of this nematode under adverse conditions. Nematodes have survived

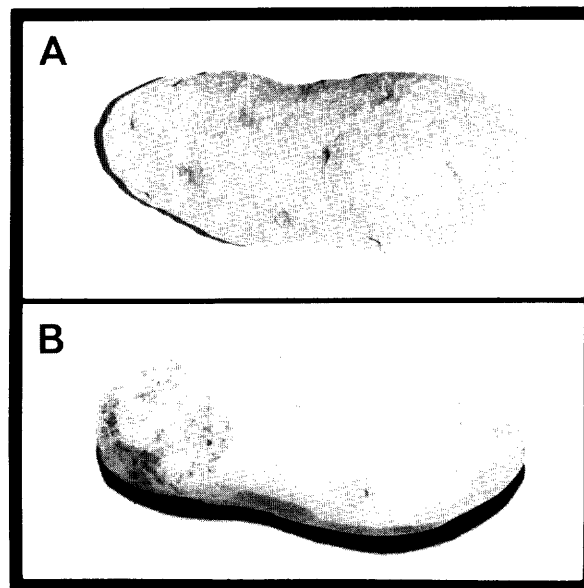


Fig. 1. Tuber symptoms caused by M. chitwoodi: (A) Infected unpeeled potato with swellings and galls. (B) Infected peeled potato with internal necrosis.

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in tubers stored for more than two years at 1 C (34 F) even though these tubers became dehydrated during storage (1). Infected tubers that had been left overwinter in the field in Idaho also contained viable eggs (1).

Soil temperatures have a significant effect on the reproduction of root-knot nematodes. Meloidogyne chitwoodi is better adapted to low soil temperatures than are M. hapla and most other common root-knot nematodes. On 'Russet Burbank' potato, some reproduction of M. chitwoodi occurs at temperatures as low as 10 C (50 F). Meloidogyne chitwoodi also reproduces significantly better and is more pathogenic than M. hapla at 15 and 20 C (59 and 68 F). Thus, in the Pacific Northwest, M. chitwoodi is able to become established and populations increase early in the season when soil temperatures are low (5). Early infection is particularly important because the reduction in tuber quality caused by M. chitwoodi is of even greater commercial significance than the reduction in root growth caused by this nematode. In the state of Washington, a crop may be termed as unsalable if tubers have 10% or more waste, which in some cases may be due to lesions or necrosis caused by M. chitwoodi.

SURVEY AND DETECTION: Symptoms caused by M. chitwoodi on potato are highly variable, depending on the cultivar of potato and population level of the nematode. In some cultivars, when nematode populations are low, root infections are often difficult to detect without the aid of magnifying lenses, and external galls may or may not develop on infected tubers. High populations of M. chitwoodi frequently cause irregular swellings or galls on roots, stolons, and tubers. Infection of 'Russet Burbank' potato tubers normally is manifested by brown lesions in the cortex and sometimes in the pith. If these symptoms are observed, infected plant parts should be submitted to a nematology laboratory to determine if M. chitwoodi is present.

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